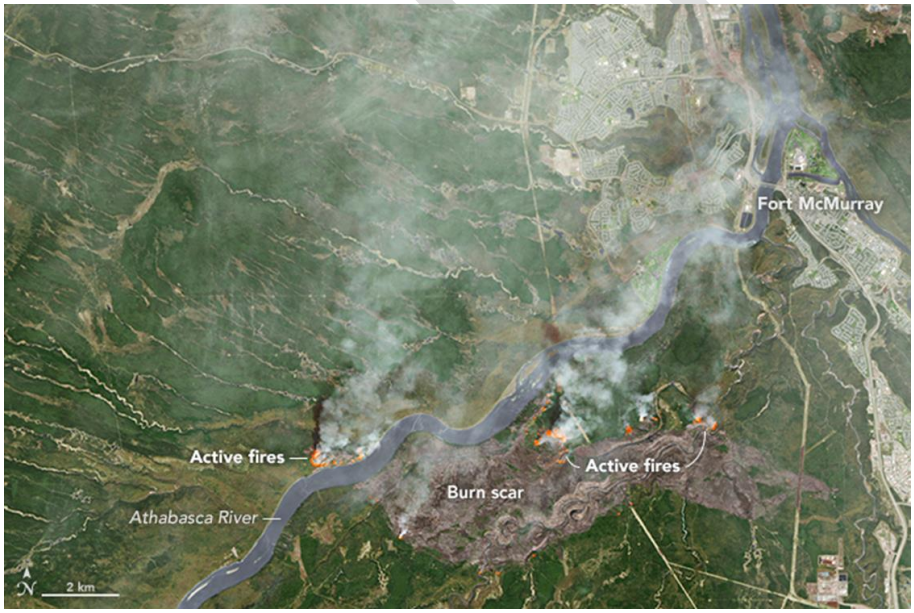
Rhode Island DEM

Exceptional Event Demonstration

Fort McMurray Wildfire May 2016



Preface: This document is intended to be used side by side with the accompanying PowerPoint presentation. References to content in the PowerPoint presentation will be frequently made, indicated by "**SLIDE#X**". Due to the graphically heavy content of the exceptional event demonstration, PowerPoint was deemed a much better tool to display in detail graphical images, animations, and graphs with higher resolution and detail, than strictly in a Word document.

I. Introduction

The Rhode Island Department of Environmental Management, in conjunction with the Rhode Island Department of Health Air Pollution Laboratory, operate an air monitoring network throughout the state for a variety of pollutants. Of particular importance~~,~~ is ozone, which is measured during the ozone season (officially March ~~April~~ 1 – September 30) for three locations (East Providence, West Greenwich and Narragansett), with data used to gauge public health impacts real time and also submitted to the EPA via the AQS (Air Quality System) database.

Commented [EPA1]: March 1 effective 2017. Last year (2016) it was April 1.

This documentation is being submitted to EPA Region I to demonstrate that the ozone data ~~exceedances of the 2015 ozone standard of 70 ppb (0.070 ppm)~~ in the state of Rhode Island at all three ozone monitors on May 25th and May 26th, 2016 should be excluded from use in determinations of exceedances or violations of the National Ambient Air Quality Standards (NAAQS) as an exceptional event caused by extreme wildfire activity in a variety of locations, but prominently featured emissions from Fort McMurray, Alberta, Canada, as per the Revised Exceptional Events Rule (40 CFR 50.14(c)(3).

As required by the rule, this document will serve to provide the following evidence.

- A narrative conceptual model of how fire activity led to the exceedances at East Providence, West Greenwich, and Narragansett ozone monitors.
- A demonstration that the wildfires affected readings at the monitors in such a way that there exists a clear causal relationship of the elevated ozone readings.
- Comparison of the event concentrations to those of non-event.
- Evidence that the events was not reasonably controllable or preventable.
- Evidence that the event was caused by human activity and is not likely to recur.
- Documentation that RIDEM completed the public comment process.

The "Initial Notification of Potential Exceptional Event" was provided by the Rhode Island Department of Environmental Management Office of Air Resources to EPA Region I in a letter dated January 9th, 2017. See below.

Commented [EPA2]: This letter and the others would be best included as an appendix, and then referenced in the text, as opposed to keeping them within the body of the text.

RHODE ISLAND
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR RESOURCES
235 Promenade Street, Room 230
Providence, Rhode Island 02908

9 January 2017

Mr. David Conroy
United States Environmental Protection Agency Region I
EPA New England
5 Post Office Square, Suite 100
Boston, MA 02109-3912

Re: Formal Initial Notification for a Potential Exceptional Event for Ozone from May 25-28, 2016

Dear Mr. Conroy:

This letter serves to notify the USEPA that the State of Rhode Island, Department of Environmental Management will be examining the aforementioned period as an exceptional event, per the Clean Air Act (CAA) section 319(b).

Preliminary data analysis indicates that significant fires in Fort McMurray, Canada and possibly elsewhere in the eastern United States may have significantly influenced an ozone episode from May 25th to May 28th.

In accordance with 40 CFR 50.14(c)(2) of the "Exceptional Events Rule", all ozone data for that period has been flagged in EPA's Air Quality System with an IF "Informational" Flag.

Feel free to call or e-mail me with any questions concerning this notification.

Sincerely,

Douglas McVay
Chief
Office of Air Resources

Cc: Robert Judge, EPA R1

The following documentation serves to meet the requirements of Clean Air Act Section 319(b), Air quality monitoring data influenced by exceptional events~~;~~ 40 CFR Section 50.14, Treatment of air quality monitoring data influenced by exceptional events~~;~~ and EPA's "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" from the updated guidance rule promulgated on September 16, 2016.

This documentation is intended to demonstrate that on May 25 and May 26, 2016 the three ozone monitors operated jointly by the Rhode Island Department of Health and the Rhode Island Department of Environmental Management experienced elevated ozone concentrations ~~exceedances~~ caused ~~in part~~ by transported smoke emissions, including ozone and ozone precursors such as~~(~~ nitrogen oxides (NOx) and volatile organic carbons (VOCs). The ~~8-hr~~ daily maximum 8-hr. average concentrations from this event are listed below.

Commented [EPA3]: Please include a map of monitoring locations and consider including a table to show the data gathered at each site.

Monitor	County	Monitor ID	Date	Daily Max. 8-hr Average Concentration (parts per million)
Narragansett	Washington	440090007	5/25/2016	0.086 ppm
West Greenwich	Kent	440030002	5/25/2016	0.078 ppm
East Providence	Providence	40071010	5/25/2016	0.071 ppm
West Greenwich	Kent	440030002	5/26/2016	0.084 ppm
Narragansett	Washington	440090007	5/26/2016	0.081 ppm
East Providence	Providence	40071010	5/26/2016	0.078 ppm

The EPA Guidance document outlines a 3-tiered approach in preparing exceptional event demonstrations. A Tier 1 demonstration is one in which a wildfire clearly influenced monitored values, either outside of the ozone season, with concentrations higher than typical that were deemed as event related, or the wildfire was in very close proximity to the monitor. These demonstrations require the least amount of evidence and documentation. The 5/25/16 and 5/26/16 events are within the Rhode Island ozone season, and although statically above normal, they are not unprecedented, and therefore a Tier 1 approach is not applicable.

A Tier 2 analysis is necessary when the wildfire impacts are less clear, and more evidence is required in a weight of evidence approach to demonstrate a causal relationship. Due to the great distance traveled with this smoke event, a minimum Tier 2 analysis is required. Tier 3 demonstrations are used when the relationship between the wildfire and ozone concentrations are the most complex, requiring the highest level of documentation. We are making this more complex demonstration.

As part of a Tier 2 analysis, the guidance document lists 2 factors for providing a clear causal relationship, with (Q) being the quantity of wildfire emissions over (d), the distance of the impacted monitors. A Q/d ratio that is over 100 tons/day/km is the threshold listed as providing

a clear causal relationship. The 2nd factor is providing analysis that the ozone concentrations when compared to non-event concentrations are in the 99th percentile for the year and past 5 years (RIDEM evaluated the past 6 years), which was the case for the 5/25/16 and 5/26/16 exceptional event.

Connecticut Department of Energy and Environmental Protection provided an in depth Q/d analysis to determine if there was a causal relationship from fire activities on the monitors. Much of this initial work has been utilized as part of a Rhode Island-specific Q/d analysis, accounting for the difference in distance to the RIDEM impacted monitors.

Rhode Island Q/d Analysis

Q is the total daily emission rate in tons per day of reactive hydrocarbons (rHC) and nitrogen oxides (NOx). EPA recommends, in the exceptional events guidance, that only 60% of the hydrocarbons should be considered reactive. Therefore the reactive hydrocarbon emissions (Ehc) become rHC = 0.6 * Ehc or 0.6 * 17,791 = 10,675 tons of reactive HC emitted during the period of interest. No adjustments are suggested for the NOx emissions. Therefore the total rHC and NOx emissions over the period are 10675 + 2965, or 13,640 tons over the six days. On average this results in a daily emission rate, or Q, of 2293 tons per day.

Estimate of d

Based on the large distance, we will not present individual analyses for each monitor, but estimate the distance from the Fort McMurray fire to the most distant point in Rhode Island. We will therefore use a value of d of 3316 kilometers, the flight distance from Fort McMurray to Little Compton, Rhode Island.

Q/d Estimate

Using the values determined above, Q/d then becomes ~~2293~~ 2,273 tpd divided by 3316 kilometer (km) or 0.69 tons per day per kilometer (tpd/km). This value is well below the EPA recommended level of 100 tpd/km indicating clear causality.

Acres	Ehc	ENOx	Q	d (km)	Q/d	Q/d per day
148,263	17,791.56	2965.26	13,640.2	3316	4.1134	0.6915
1,457,909	174,949.1	29,158.18	134,127.6	3316	40.8179	

Taking a less conservative approach and using the maximum extent of the burn area over the life of the fire, the result would be a Q/d of ~~40.8~~ 40.4 tpd/km. Still sufficiently below the EPA recommended threshold for establishing clear causality. Recalling that a worst case fuel loading would increase our results by a factor of six, Q/d would in this case result in 240 tpd/km and would indicate clear causality. While this approach might be justified by the ongoing smoldering of the peat, the intensity of the Fort McMurray fire, variability in the burn rate and other factors, it is difficult to justify without further details that may only be obtained through estimates which introduce their own error.

Commented [EPA4]: Since this document should be stand-alone, please include CT DEEP's Q/d analysis as an appendix to this demonstration. Many of the next 7 comments in this section could be addressed by including the complete CT analysis.

Commented [EPA5]: Please include a reference or explanation for where this number came from.

Commented [EPA6]: Please include a reference or explanation for where this number came from.

Commented [EPA7]: Please include here an brief explanation for why six days is being used.

Commented [EPA8]: Please check math. 13,640/6 is 2,273, not 2,293.

Commented [EPA9]: Please check math. 4.1134/6 is 0.6856, not 0.6915.

Commented [EPA10]: Please check math. 134,127.6/3316 is 40.4486, not 40.8179.

Commented [EPA11]: This sentence references something from CT's Q/d analysis that has not been discussed in your demonstration. Please provide explaination.

Taking a slightly different approach we consider the basis for the EPA guidance and look at emissions from one of the four fires EPA relied on in developing their guidance. Appendix A2 of the EPA guidance indicates that EPA based their conclusions on 12 km grid Community Multiscale Air Quality (CMAQ) modeling of four 2011 multiday fires: Wallow, Waterhole, Big Hill and Flint Hills. Emissions from the fires were based on a program called SMARTFIRE. The SMARTFIRE fire information system is a framework maintained by the US Forest Service for aggregating, associating, and reconciling wildland fire information from disparate sources. Using information available on the Wallow Fire, we approximate the emissions that might be calculated for the Fort McMurray fire.

The Wallow Fire burned in eastern Arizona and western New Mexico from May 29, 2011 through July 8, 2011 and burned 841 square miles (538,240 acres) by June 26th. The maximum daily emissions from that fire were reported as approximately 15,000 tons of reactive volatile organic compound (rVOC) and 1,000 tons of NOx. [Simulating Fire Event Impacts on Regional ozone (O3) and particulate matter less than 2.5 microns (PM2.5) and Looking Forward Toward Evaluation, Kirk Baker, EPA October 5, 2015 and Using SOAS and related field study data for scientific and regulatory modeling, Kirk Baker, EPA, undated; both are slide presentations] If we scale this fire up by a factor of three to approximate the acreage burned in the Fort McMurray fire, then we have daily emissions as high as 45,000 tons for rVOC and 3,000 tons for NOx. These emissions produce a Q of 48,000 tpd and Q/d becomes 14.6 – still well below EPA expectation for causality.

Commented [EPA12]: Define/explain SOAS

Noting the wide variability in emissions estimates from different approaches, and as the Q/d method does not generally satisfy the expectation of a clear causal impact, we present other evidence demonstrating that the plume from the Fort McMurray fire caused elevated ozone levels in Rhode Island in Tier 2 and Tier 3 approaches. Therefore, this document will attempt to show a clear causal relationship that (1) the wildfire emissions were transported to the monitor and (2) that the wildfire emissions impacted ozone concentrations.

Statistical Examination of Exceptional Event with Non Events

With the arrival of the plume on 5/25/16, all three of the ozone monitors in Rhode Island experienced exceedances of the 2015 ozone standard on both days. Additionally, widespread exceedances were recorded in New Jersey (16/17 monitors), New York (29/30 monitors), and Connecticut (11/12) monitors. Massachusetts experienced exceedances with 9/15 monitors, with three additional monitors reaching the standard.

Section 3.5.1 of EPA's September 16, 2016 wildfire guidance document entitled "Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations" states that one of the factors for a Tier 2 analysis involves showing that the exceedance due to the exceptional event "is in the 99th or higher percentile of the 5-year distribution of O3 monitoring data." That can be shown for some of the exceedances May 25 and 26 but not all as described below.

The table below, ~~First let's~~ examines the historical context for the 3 monitors in question for the previous 6 years, 2011-2016, for the months of May and June only. For May 25th, Narragansett (0.086 parts per million(ppm)) exceeded 99th percentile for the period. West Greenwich was below 99th percentile but tied 98th percentile (0.078 ppm), while East Providence (0.071 ppm) was below 99th and 98th percentile. For May 26th, West Greenwich (0.084 ppm) and East Providence (0.078 ppm) both exceeded 99th percentile. Narragansett (0.081 ppm) was below 99th percentile, but tied 98th percentile.

Monitor	Date	Daily Max. 8-hr Average Concentration	May-June 2011-2016 99th Percentile	May-June 2011-2016 98th Percentile
Narragansett	5/25/2016	0.086 ppm	0.084 ppm	0.081 ppm
West Greenwich	5/25/2016	0.078 ppm	0.082 ppm	0.078 ppm
East Providence	5/25/2016	0.071 ppm	0.076 ppm	0.076 ppm
West Greenwich	5/26/2016	0.084 ppm	0.082 ppm	0.078 ppm
Narragansett	5/26/2016	0.081 ppm	0.084 ppm	0.081 ppm
East Providence	5/26/2016	0.078 ppm	0.076 ppm	0.076 ppm

~~Next, let's~~Table X below examines the historical context for the 3 monitors in question for the entire ozone season, April to September, for the years 2011-2016. On May 25th, Narragansett (0.086 ppm) exceeded 99th percentile for the period, while West Greenwich tied the 99th percentile (0.078 ppm). East Providence (0.071 ppm) was lower than the 99th percentile, but exceeded 98th percentile. For May 26th, West Greenwich (0.084 ppm) eclipsed 99th percentile, while East Providence (0.078 ppm) tied ~~98th~~ 99th percentile. Narragansett (0.081 ppm) also tied 99th percentile.

Monitor	Date	Daily Max. 8-hr Average Concentration	Ozone Season 2011-2016 99th Percentile	Ozone Season 2011-2016 98th Percentile
Narragansett	5/25/2016	0.086 ppm	0.081 ppm	0.075 ppm
West Greenwich	5/25/2016	0.078 ppm	0.078 ppm	0.072 ppm
East Providence	5/25/2016	0.071 ppm	0.078 ppm	0.070 ppm
West Greenwich	5/26/2016	0.084 ppm	0.078 ppm	0.072 ppm
Narragansett	5/26/2016	0.081 ppm	0.081 ppm	0.075 ppm
East Providence	5/26/2016	0.078 ppm	0.078 ppm	0.070 ppm

West Greenwich

5/25/16 8-hr ozone is tied for 2nd highest for entire ozone season (2011-2016)

8-hr ozone tied for 7th highest for May/June (2011-2016)

5/26/16 8-hr ozone is tied for 8th highest for entire ozone season (2011-2016)

8-hr ozone is 2nd highest for May/June (2011-2016)

Narragansett

5/25/16 8-hr ozone is tied for 3rd highest for entire ozone season (2011-2016)

8-hr ozone is tied for 2nd highest for May/June (2011-2016)

5/26/16 8-hr ozone is tied for 7th highest for entire ozone season (2011-2016)

8-hr ozone is tied for 6th highest for May/June 2011-2016

East Providence

5/25/16 8-hr ozone is 14th highest for entire ozone season (2011-2016)

8-hr ozone is 6th highest for May/June (2011-2016)

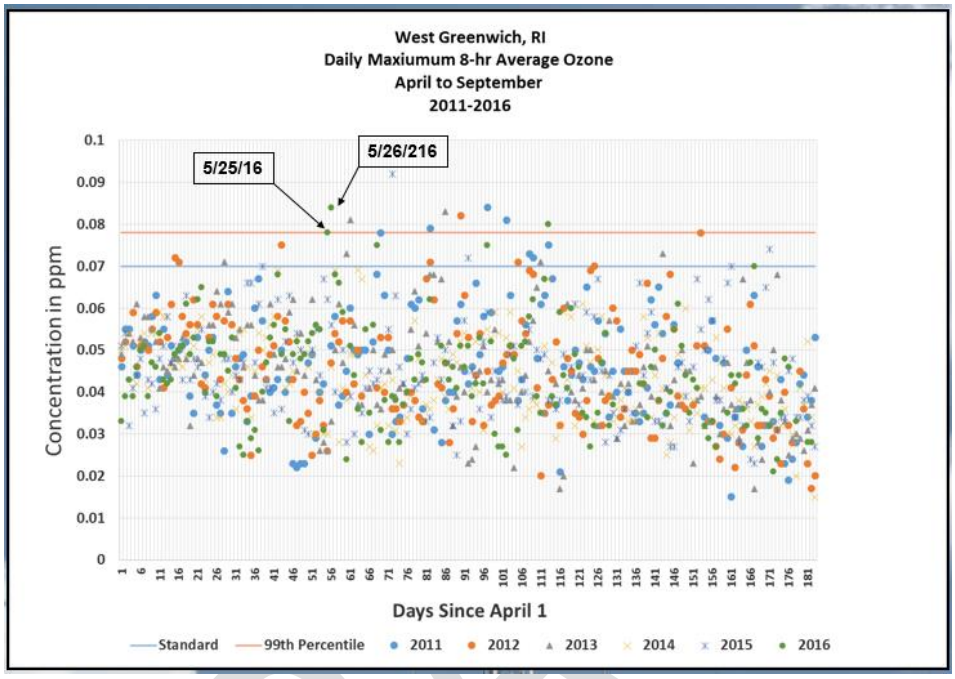
5/26/16 8-hr ozone is tied for 8th highest for entire ozone season (2011-2016)

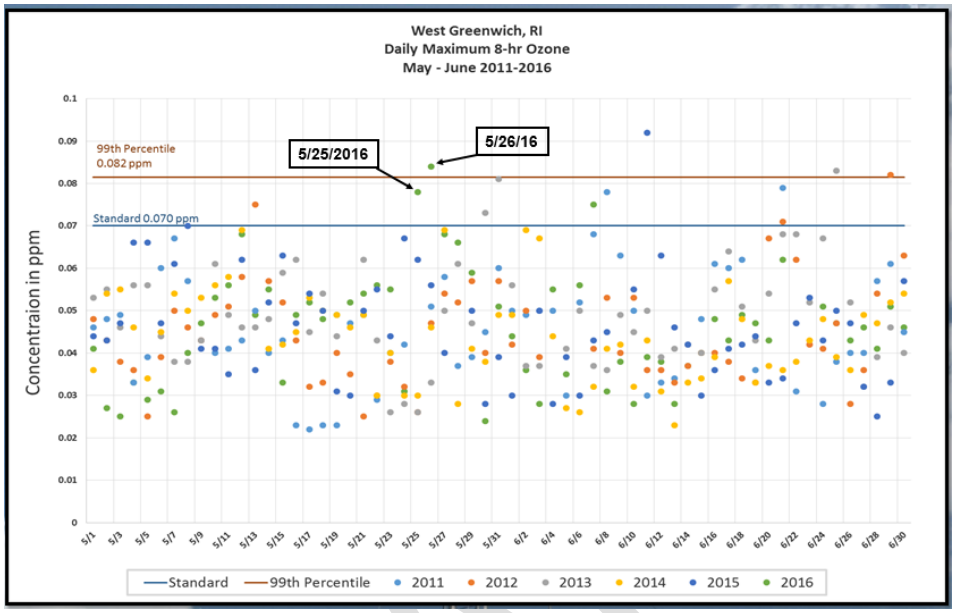
8-hr ozone is tied for 3rd highest for May/June (2011-2016)

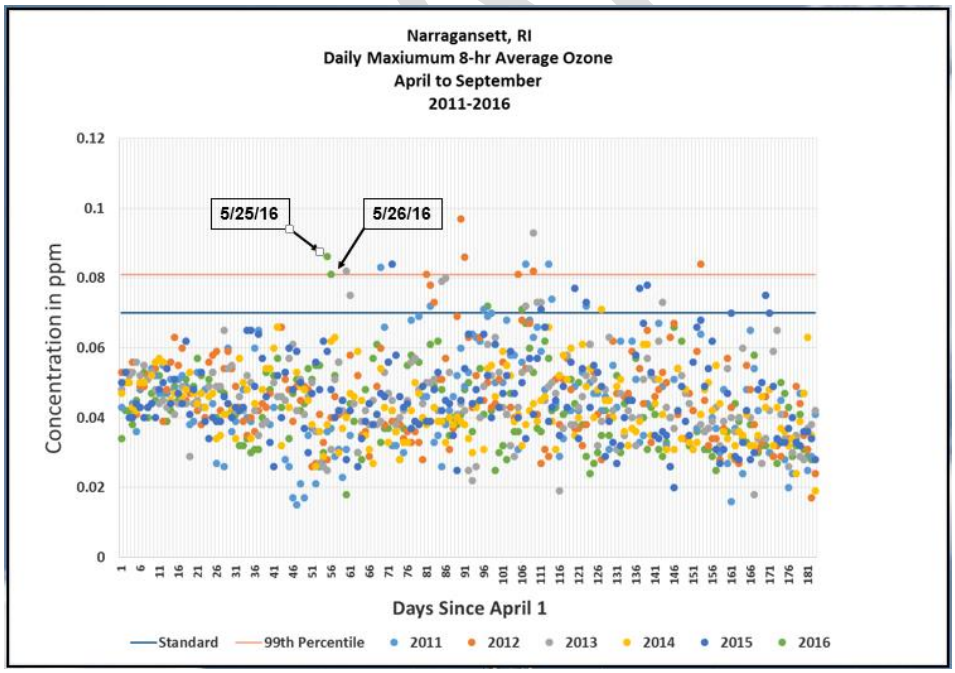
See a graphical representation of the 2011-2016 April to September ranges, and 2011-2016 May June ranges for all three locations below.

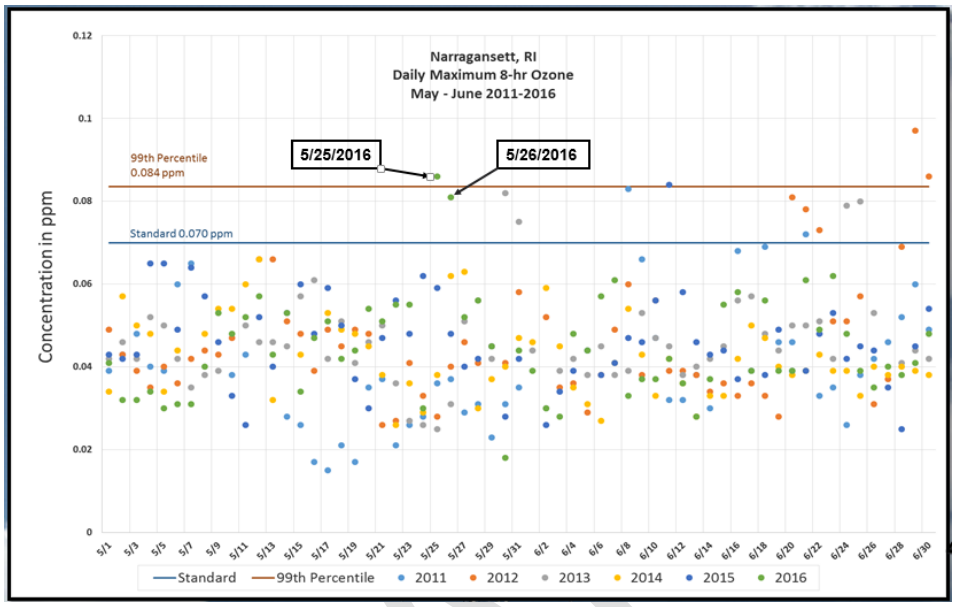
Commented [EPA13]: A summary or description of what the graphs are showing and their significance to the excpetional event demonstration should be included in the discussion here.

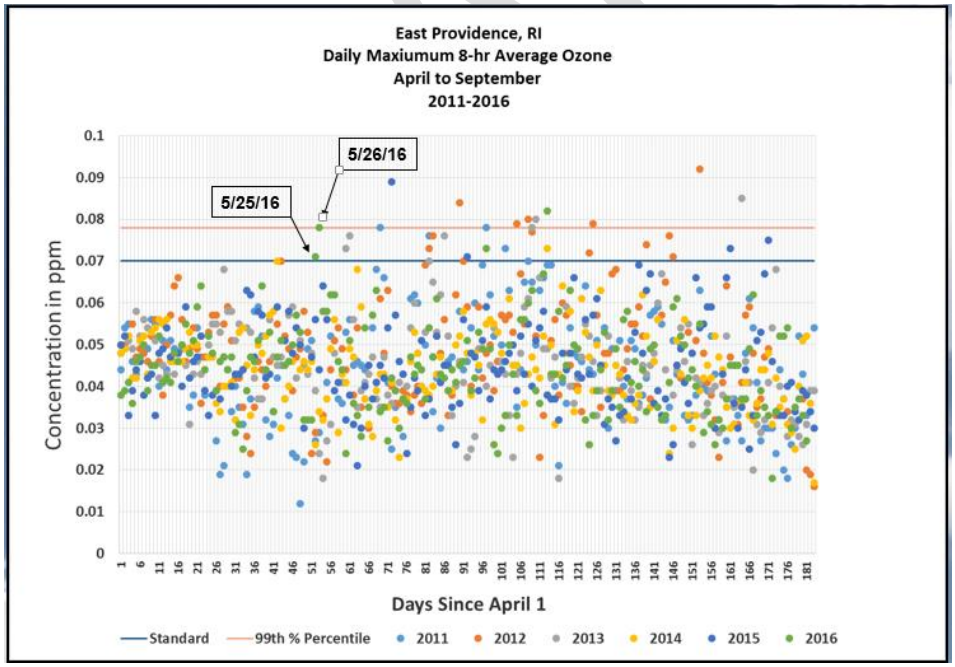
Commented [EPA14]: Please include captions on all graphs. Indicate either in these captions or in footnotes that the "Standard" is the 70 ppb 8-hour ozone NAAQS. Also, each April through September figure below should label the NAAQS standard line, and the value of the 99th percentile line.

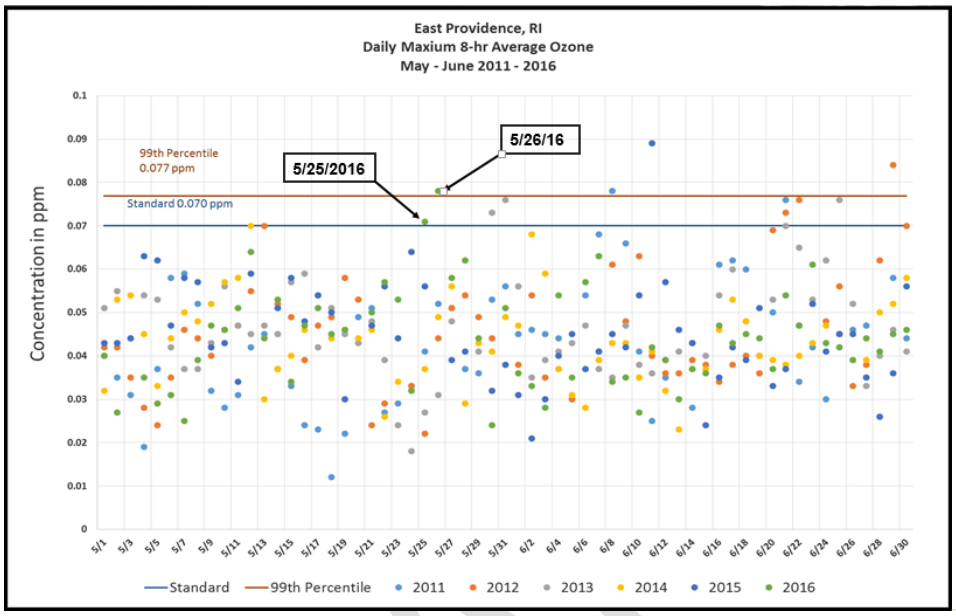

West Greenwich, RI
Daily Maxiumum 8-hr Average Ozone
April to September
2011-2016
5/25/16
5/26/216
Concentration in ppm
Days Since April 1
Standard
99th Percentile
2011
2012
2013
2014
2015
2016


West Greenwich, RI
Daily Maximum 8-hr Ozone
May - June 2011-2016
99th Percentile
0.082 ppm
Standard 0.070 ppm
5/25/2016
5/26/16
Concentraion in ppm
Standard
99th Percentile
2011
2012
2013
2014
2015
2016


Narragansett, RI
Daily Maxiumum 8-hr Average Ozone
April to September
2011-2016
5/25/16
5/26/16
Concentration in ppm
Days Since April 1
Standard
99th Percentile
2011
2012
2013
2014
2015
2016


Narragansett, RI
Daily Maximum 8-hr Ozone
May - June 2011-2016
Concentration in ppm
99th Percentile
0.084 ppm
Standard 0.070 ppm
5/25/2016
5/26/2016
Standard
99th Percentile
2011
2012
2013
2014
2015
2016


East Providence, RI
Daily Maxiumum 8-hr Average Ozone
April to September
2011-2016
Concentration in ppm
5/26/16
5/25/16
Days Since April 1
Standard
99th % Percentile
2011
2012
2013
2014
2015
2016



Commented [EPA15]: According to table above, 99th percentile is 0.076 ppm (not 0.077 ppm). Please verify 77 ppb is correct.

Rhode Island Design Value and Regulatory Significance

A site is in violation for the NAAQS eight-hour standard if the monitored design value for that site is in exceedance of 70 parts per billion (ppb). The design value is calculated by averaging the fourth highest maximum daily eight-hour ozone concentrations measured at each site in three consecutive years. For the most recent certified data, 2013-2015, the design value for the Narragansett monitor is 73 ppb, while West Greenwich and East Providence both have design values of 70 ppb. Refer to the Rhode Island attainment designation letter sent to EPA on 9/27/16. **Slide #1** (also below) reveals the design value for the 2014-2016 seasons, and how those values are impacted when exceptional event values for 5/25/16 and 5/26/16 are excluded from the design value for that period, which drops the design value 2 ppb for all three ozone monitors. Note that the design values are in attainment of the standard even when *including* the exceptional event values.

Commented [EPA16]: Please consider a lighter background for this slide on the powerpoint because it is hard to read due to slide background interference

Commented [EPA17]: Please elaborate on the regulatory significance, including a discussion of critical 4th high values.

Design Values 2014-2016							
East Providence Top 8-hr			Year	4th Highest		Design Value 2014-2016 (ppb)	
7/22/2016	0.082		2014	64			
5/26/2016	0.078		2015	71	68	includes exceptional	
7/6/2016	0.073		2016	71	66	dropping exceptional	
5/25/2016	0.071	4th Highest	2016 (EE)	64			
7/21/2016	0.067						
4/22/2016	0.064	4th Highest excluding					
		exceptional event					
West Greenwich Top 8-hr			Year	4th Highest		Design Value 2014-2016 (ppb)	
5/26/2016	0.084		2014	67			
7/22/2016	0.08		2015	70	70	includes exceptional	
5/25/2016	0.078		2016	75	68	dropping exceptional	
6/7/2016	0.075	4th Highest	2016 (EE)	68			
7/6/2016	0.075						
5/12/2016	0.068	4th Highest excluding					
		exceptional event					
Narragansett Top 8-hr			Year	4th Highest		Design Value 2014-2016 (ppb)	
5/25/2016	0.086		2014	63			
5/26/2016	0.081		2015	77	70	includes exceptional	
7/6/2016	0.072		2016	71	68	dropping exceptional	
7/15/2016	0.071	4th Highest	2016 (EE)	66			
7/16/2016	0.067						
8/24/2016	0.066	4th Highest excluding					
		exceptional event					

Conceptual Model

Wildfire Event and Smoke Transport to Rhode Island

On May 1, 2016 a fire began in a remote portion of forest southwest of Fort McMurray, Alberta, Canada. Only two days later, the fire forced the largest wildfire evacuation in Alberta history and eventually spanned approximately 589,995 hectares (1,500,000 acres) before being declared under control on July 5, 2016. Three days after the fire began, it was already deemed extreme by Alberta Agriculture and Forestry.

Date	Hectares	Acres
5/4/16	10,000	25,000
5/5/16	85,000	210,000
5/6/16	100,000	250,000
5/7/16	156,000	390,000
5/16/16	285,000	700,000
5/21/16	504,443	1,246,510

By mid-June, rain and cooler temperatures aided in the firefighting effort. June 13 marks the first date the fire was held in check since becoming out of control. No official cause has been

determined to date, though it is suspected to be human caused. However, the conditions leading up to the outbreak were a bit unusual. A hot air mass (temps 90 degrees or higher) with very low humidity (less than 20%) combined with intense winds of 45 mph on 5/4/16 contributed significantly to the fire's growth. The conditions prior to the outbreak were unusually dry, with a low snowpack due to an El Nino cycle, followed by an abnormally warm and dry spring which resulted in a fire season start some four weeks sooner than usual, creating the dry tinder and soil conditions.

SLIDE #2 (https://www.giss.nasa.gov/research/features/201605_fires/) reveals land surface temperature anomalies nearly 10 degrees centigrade above average for the period of 4/26/16 to 5/3/16. Although specific fires cannot be attributed to climate change, some have theorized a possible correlation between climate change, longer dry seasons, and fuel aridity. It's unclear if extreme fire events such as the Fort McMurray fire may be more frequent in the future, but it is known that forest fire smoke is part of a normal summertime atmosphere.

SLIDE #3 is an animation from 5/18/16 – 5/25/16 of the daily Hazards Mapping System (HMS) website (http://www.ospo.noaa.gov/Products/land/hms.html), which generates a daily fire smoke analysis using sensors, environmental, and satellite data. This animation shows the migration of the plume from the Fort McMurray (and other Canadian fires), along with a southern plume associated with the Yucatan Peninsula fires in Mexico. At various times during this period, smoke was also clearly visible in satellite images ~~on days when the cloud cover was not obscuring the smoke~~ as seen on 5/20/16, 5/22/16, and 5/24/16 on **SLIDE#4** (https://worldview.earthdata.nasa.gov/). **SLIDE #5** is a loop of 72 hr trajectories for Providence along with the daily HMS smoke analysis overlay (http://airnowtech.org/).

SLIDE #6 is an animation from 5/20/16 – 5/28/16 of AOD (aerosol optical depth), with warm colors indicating higher AOD (higher aerosol concentrations). This satellite product is only available in relatively cloud free areas, as the sensor is not able to detect AOD in significant cloud cover. A lobe of the plume grazes Rhode Island on 5/20/16 with some ground evidence, while the brunt of the plume arrives early on 5/25/16 and reaches surface level with significant ground level smoke at the monitors as shown later on **SLIDES #50-54**.

Similar satellite and aerosol index composites track the plume well as it migrated southward to the Upper Midwest/Great Lakes Region on 5/18/16 (**SLIDE #7**), as it moved aloft over the Upper Midwest in northwest flow (**SLIDE #8**), and arrived in the Northeast on 5/20/16, with the brunt of the smoke remaining aloft (**SLIDE #9**). All satellite aerosol composite slides courtesy of CTDEEP.

As mentioned, there are indications of additional smoke influence from Mexican wildfires impacting RI. Satellite data indicated significant fires in early May over much of the Yucatan Peninsula. There is little specific information on the cause of these fires, but typically February to May is the dry season in this region, with fires caused both intentionally for agricultural purposes or from lightning strikes. These fires will not be examined as in depth as Fort

Commented [EPA18]: Please include the event days, 5/26 and 5/27, in the time-lapse animation. Additionally, RI DEM should provide more background on the HMS product, including a discussion that detected smoke may only be aloft and that HMS cannot show smoke at night or during cloudy conditions.

See following link for more information: http://journals.ametsoc.org/doi/pdf/10.1175/2008WAF2222165.1

Commented [EPA19]: Please include more discussion explaining what the animation is showing to support the exceptional event demonstration.

Commented [EPA20]: Please indicate where said ground evidence on 5/20/16 can be found. It is not clear from SLIDES #50-54 that there is ground level smoke on May 20.

McMurray, and it's believed the Fort McMurray provided the greatest impact on the exceptional event, with the Yucatan fires acting to exacerbate.

The Navy smoke model (https://www.nrlmry.navy.mil/aerosol_web/) picked up on significant smoke surface concentrations over Mexico and the Gulf of Mexico on 5/23/16 (**SLIDE #10**). The HMS analysis also showed a significant plume over the Gulf of Mexico on 5/22/16 and 5/23/16 (**SLIDE #11**). 850 mb analysis on 5/22/16 and 5/23/16 shows transport flows from the south southwest originating from the plume, delivering smoke to the north (**SLIDE #12**) with the Mexican and Fort McMurray plumes appearing to link on 5/24/16 and 5/25/16 (**SLIDE #13**) and becoming entrained in the northwest flow (**SLIDE #14**) and eventually into the Northeast (images from http://www2.mmm.ucar.edu/imagearchive/ by way of the NWS Storm Prediction Center). The entrainment of the Yucatan smoke and increase in precursors, along with very warm temperatures aloft allowed for enhanced ozone production.

The Fish and Wildlife Service's Branch of Air Quality administers the air monitoring program IMPROVE, as part of a Regional Haze network to establish air quality trends affecting refuge resources. Sampling of Potassium (k), a useful indicator of smoke, occurs every three days at Seney National Wildlife Refuge (**SLIDE #15**) on the Upper Peninsula of Michigan, a Federal Class I area. **SLIDE #16** (courtesy of CTDEEP) indicates elevated K and aerosol spikes on 5/24/16 that coincided with and ozone exceedance on a normalized scale. Trajectories reveal that this is the same air mass and plume responsible for the exceptional event in Rhode Island.

Exceptional Event Meteorology and Trajectories

A smoke plume has already been established and tracked into Rhode Island under favorable transport conditions. **SLIDE #17** is an animation that shows the daily air quality index from 5/20/16 to 5/28/16. ~~The~~ An area of elevated ozone develops under stagnation in the Upper Midwest, ~~than~~ then traverses into the Great Lakes Region, before arriving and peaking in the Northeast on 5/25/16 and 5/26/16.

The National Oceanic and Atmospheric Administration (NOAA) HYSPLIT model was run using the AirNOW Tech Navigator tool (http://airnowtech.org/navigator/) to produce 36 hour back trajectories of air parcel movement at 100, 500, and 1500 meters. Wildfire Guidance recommends heights no lower than 100m to avoid terrain interference, and no higher than 1500m to confine the parcel in the mixing layer. ~~The~~ Narragansett is the farthest monitor from the smoke source and the other monitoring locations are located in close proximity to each other (Narragansett to East Providence is 24 miles, Narragansett to West Greenwich is 20 miles). The trajectories are serving two purposes. One is to show that the flows on 5/25/16 that produced the ozone exceedances are atypical of high ozone events. Secondly, the trajectories show that flows were originating along a course with which the plume was traveling.

On 5/24/16, there was an area of low pressure just offshore of Southern New England with an occluded front extending from Cape Cod to off the coast of Nova Scotia. A closed upper level low was situated just off the coast of Southern New England (see **SLIDE #18** for 5/24 NOAA

Commented [EPA21]: Please see comment #13 in our letter.

Commented [EPA22]: As noted in our comment #4 and 6 of our letter, please include a more in-depth discussion of upwind ozone, meteorology, and smoke to better narrate the movement of the pollutants to Rhode Island. As noted in comment #7, the CSN data from upwind locations in MI, NY, CT, etc. may be useful to this case.

Commented [EPA23]: As discussed in comment #6 of our letter, it is also expected that seperate trajectories be done for each monitor.

Commented [EPA24]: Please match up with the additonal forward and back trajectories recommended in comment #6 to back up this statement.

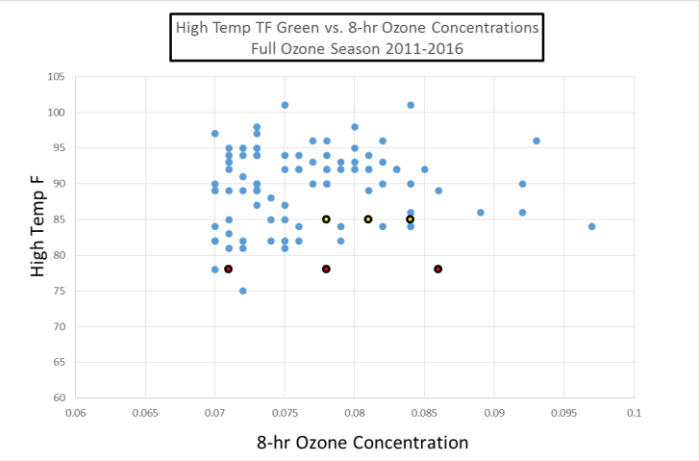
surface and 850 mb analysis, and ETA 500 mb analysis). The surface wind component is from the northeast (fresh marine air) up to 500 meters or more, as shown by the HYSPLIT trajectory run for 5/24 (**SLIDE #19**). At a height of 1500 meters, flows ranged from the south and southeast. Early on 5/25/16, the trajectories began to back to the north and eventually northwest at 500 and 1500 meters by 10 AM, while surface flows had back rotated to the southwest (again see **SLIDE #19**, click to animate/advance). The surface, 500 mb, and 850 mb low pressure troughs have both begun to shift east and northeast (see **SLIDE #20**). By this time, the directional change in winds at the surface up to 500 mb or more (again refer to **SLIDE #19** animation) had tapped into the well-established smoke plume that had been lingering west and northwest of the area, and the plume was transported into Rhode Island's air shed.

Commented [EPA25]: Again, please match up with the additonal forward and back trajectories recommended in comment #6 to back up this statement.

The synoptic pattern at the surface and aloft and HYSPLIT trajectories or atypical of a typical ozone event in this area, which will be evaluated more in depth.

By 5/26, the exceptional event did begin to take on some characteristics of a traditional non-event day of ozone exceedances. At the surface (**SLIDE #21**), a stationary boundary was situated just northwest of the state, 850 mb flows had shifted more west and southwest, and 500 mb flows exhibited a more westerly regime. See (**SLIDE #22**, for trajectories on 5/26. All are favorable regimes for ozone transport. However, by that time, the smoke and ozone plume had been already well entrenched and continued to exacerbate and enhance the high ozone in the air shed. Although there is indication~~evidence~~ of precursors and smoke impacting Rhode Island on 5/27 and 5/28, we are focusing this demonstration on May 25-26 because there is clearer indication of the influence of smoke on these days. However, trajectories (**SLIDE #23**) and 850 mb flows (**SLIDE #24)** had shifted to a more south southwesterly component with substantial fetch over the ocean, mixing in cleaner marine air, and reducing impacts of the plume. There were western areas of the Northeast that continued to be impacted by the plume on these dates that were not as affected by the mixing of cleaner marine air.

There are several meteorological predictor variables (temperature, wind speed, wind direction, cloud cover, relative humidity, and mixing heights) for forecasting high ozone. It is well known that days with high ozone correlate strongly with high maximum temperatures. When examining a plot of ozone exceedances for the full ozone seasons for 2011-2016, May 25th especially appears as an outlier. NWS observed high temperatures were plotted along with 8-hr ozone values on exceedance days. The red dots indicate 5/25/16, with yellow as 5/26/16.



The high temperature at TF Green on 5/25/16 only reached 78F. The average daily maximum temperature for ANY exceedance of 0.070 ppm standard for that period was 89F. On 5/26/16, as mentioned, was still heavily influenced by the persistence of the plume, but more closely resembled a non-event ozone exceedance, as high temperatures reached 85F at TF Green on that date. As was the case in the upper Midwest on 5/19/16 and 5/20/16, meteorological conditions on 5/25/16 and 5/26/16 were not favorable for such elevated ozone readings.

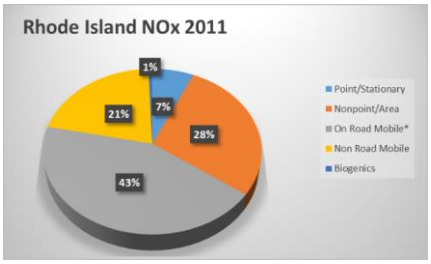
Examination of Typical Non-Event Ozone Exceedances

It is hoped that in establishing the typical non-event synoptic weather, ozone precursor conditions, trajectories, and the discrepancies between non-events and the exceptional event of May 25th and 26th will expose the uniqueness of conditions on those days.

Rhode Island's geography is characterized by coastal lowlands around Narragansett Bay and rolling hills central and north, with the highest point only 812 feet above sea level. The state experiences a humid continental climate which is strongly influenced by its proximity to the Atlantic Ocean with Narragansett Bay intersecting the state, with a tidal shoreline of 384 miles. The state experiences all four seasons, prevailing westerly flow, with summer heat and humidity along with deep continental polar air masses in winter. Interior portions well away from the coast tend to have more extreme temperatures fluctuations as opposed to the immediate coast which is moderating by ocean temperatures.

Rhode Island's weather is highly changeable, therefore its air quality is also highly changeable and is substantially affected by ~~the~~ transport. Based on the most recent processed emissions inventory for 2011, nearly 43% of NOx emissions (an ozone precursor) originated from on road mobile sources. The West Greenwich Regional PAMS Type I location ozone monitor was established to measure upwind background measurements, as it situated in a heavily wooded,

unpopulated region, far from and even upwind of any potential mobile source impacts of precursor pollutants. Concentrations at West Greenwich are typically assumed to be nearly all transport. This is important, as this location was significantly impacted by the exceptional event, especially on 5/26/16.



It should be noted that since ozone monitoring began in the state, there has been a measurable decrease in high ozone days. Ozone concentrations during the summer season in Rhode Island are influenced by several factors and weather scenarios that result in the highest 8-hr concentrations each season.

The "classic" conceptual event involves surface flow along the 95 corridor from more densely populated and industrialized precursor pollution source regions of Connecticut, New York, New Jersey, eastern Pennsylvania via a generally southwest or west southwest low level component. Mid-level transport is also from the southwest or west southwest, with a more westerly component in the upper levels. Ozone plumes may pool in Long Island sound and migrate along coastal Rhode Island before being brought inland with light and localized sea breezes. Other surface flow regimes from the west can transport ozone plumes within relatively stable marine air along Long Island sound (and again from more precursor rich locations) before also with localized coastal sea breezes bringing the plume inland. The sea breezes typically become more vigorous during afternoon peak heating times. These scenarios are most often associated with Bermuda high anticyclone in the Atlantic and localized ridging (high pressure/high temperature heights) aloft, which provide the surface flows from the southwest and west southwest, all within a relatively stable air mass, with limited clouds to allow for the significant UV light necessary for the chemical formation of ozone.

Ozone transport and formation can also be exacerbated by an approaching cold front (with no associated precipitation) situated west of the state during peak daylight heating. The front acts as a sort of squeegee, resulting in a substantial buildup of precursors in the prefrontal warm sector. Stagnation events as a result of days of high pressure, upper level subsidence, and light mixing may also compound ozone readings over the course of several days. But in Rhode Island, local emissions are not substantial enough for significant local ozone formation, or immediately problematic upwind formation in Massachusetts, with our highest days only resulting from transport from more emissions rich locations.

Stronger sea breezes or surface southerly wind gradients typically result in the mixing in of cleaner, precursor deprived maritime air masses, which will limit ozone exceedances. Narragansett and East Providence, due to their proximity to the ocean, are especially susceptible southerly gradients ushering in clean marine air. The passage of a surface cold front, a wind switch to the west, northwest, and north results in increased mixing of air sourced from "cleaner" less populated, less polluted source regions. Lastly, other flows not consistent with high ozone concentrations are southeast, east, and northeast, as those directions bring in typically cleaner air from over the ocean.

For purposes of this demonstration, several non-event days with the highest 8-hr ozone exceedances for the six year period 2011-2016 will be examined.

Commented [EPA26]: As indicated in comment #9, RI DEM should be looking at typical ozone exceedances days that do not have smoke influence. This may necessitate looking at days other than those with the highest 8-hour averages in the six year period.

6/11/2015

This date experienced 8-hr averages of 92 ppb (West Greenwich, tied for 3rd highest), 89 ppb (East Providence, 4th highest), and 84 ppb (Narragansett, tied 7th highest).

Per **SLIDE #25** the synoptic pattern for this event involved an offshore Atlantic ridge of high pressure (Bermuda High), a 500 mb trough dipping down from southeast Canada, with a slow moving cold front approaching from the northwest with no associated precipitation. Cold fronts in the Northeast during the summer typically move slowly with little momentum, often stalling near the coast or just offshore, and feature more a density difference (dry denser air behind with humid buoyant air prefrontal). As mentioned precursors tend to accumulate ahead of the front. High temperature this day at TF Green Airport reached 86F.

Trajectories in **SLIDE #26** reveal a very favorable southwest low level flows from the southwest with a direction that limits cleaner marine air influence. Directions veer with height to 500m, originating emissions rich Ohio, Pennsylvania, Northern New Jersey, New York, and the I-95 corridor through Connecticut. Upper flows at 1500m are westerly, as influenced by the weak 500 mb trough to the north. Note, the HMS smoke overlay indicates that this date may have been influenced by fire smoke.

Commented [EPA27]: RI DEM should consider removing this selection as a "non-event" typical ozone day because it is indicated that there may have been a smoke influence. It would be beneficial to show that historical typical elevated ozone events do not exhibit the same characteristics as the days of this proposed exceptional event.

8/31/2012

This date experienced 8-hr averages of 92 ppb (East Providence, tied 3rd highest), 84 ppb (Narragansett, tied 7th highest), and 78 ppb (West Greenwich, tied 13th highest).

SLIDE #27 shows high pressure was located offshore and south of RI, with a cold front well off to the northwest, and a pre frontal trough draped northeast to southwest along the northeast. A ridge of high pressure is evident over the East Coast at 500 mb, with a trough located well north of RI into Canada, with flows a bit west northwest ahead of the approaching trough. Flows at 850 mb are generally straight west. High temperature at TF Green Airport reached 90F.

Trajectories on **SLIDE #28** show very favorable flows at both 100 and 500m from a west southwest component from favorable transport areas, with an evident plume in New Jersey, Long

Island, Coastal Connecticut, and into Rhode Island. Flows originate from the west northwest at 1500m.

6/29/2012 – 6/30/12

6/29/12 experienced the highest 8-hr ozone reading of the past six years, 97 ppb (Narragansett), with 84 ppb (East Providence, tied 7th highest), and an 82 ppb (West Greenwich, tied 9th highest). Only Narragansett experienced an exceedance on 6/30/12, although it was the 5th highest reading of the period at 86 ppb and was a coastal only event.

Synoptically (**SLIDE #29**), this event was very much prefrontal influenced, with an approaching cold front oriented north northeast to southwest, with a tropical system well offshore. At 850 mb, winds were southwest, with west northwest flows at 500 mb, with a weak trough over Rhode Island. This event may also have been smoke influenced, as the HMS analysis shows widespread smoke over the entire Northeast. This event lasted into 6/30/12 as the front stalled just offshore of New England, with only Narragansett experiencing an exceedance on that day, as the frontal boundary had appeared to shift and stall at the coast, with any smoke lingering in Southern New England. High temperature at TF Airport reached 84F on 6/29/12 and 89F on 6/30/12.

Commented [EPA28]: RI DEM should consider removing this selection as a "non-event" typical ozone day because it is indicated that there may have been a smoke influence. It would be beneficial to show that historical elevated ozone events do not exhibit the same characteristics as the days of this proposed exceptional event.

Trajectories once again are southwest at 100 and 500m, with a northwest flow at 1500m on 6/29/12 (**SLIDE #30**) shifting more westerly at 100 and 500 m, and continued northwest at 1500m on 6/30/12 (**SLIDE #31**).

9/11/2013

This date experienced an 8-hr reading of 85 ppb (East Providence, 6th highest event) with no exceedances at the other monitors.

Surface high pressure was located offshore (**SLIDE #32**), with a broad ridge over much of the Eastern US at 500mb, 850 mb flows from the west, and a trough again located to our northwest, with a frontal boundary approaching the eastern Great Lakes. The high temperatures at TF Green Airport was 92F.

Trajectories (**SLIDE #33**) at 100 m were from the southwest, and again at 500 and 1500 m up into Rhode Island, with a dip from the west to northwest in the flow around Eastern Pennsylvania and New Jersey. Again, the HMS product is alluding to smoke for Southern New England for the 9/11/2013 analysis.

Commented [EPA29]: RI DEM should consider removing this selection as a "non-event" typical ozone day because it is indicated that there may have been a smoke influence. It would be beneficial to show that historical elevated ozone events do not exhibit the same characteristics as the days of this propsosed exceptional event.

Pollution Wind Roses

RIDEM utilizes Agilaire, LLC software to manage our air quality monitoring data activities. Using this software pollution roses were ~~generating~~ generated for the months of May and June for 2014-2016 using ozone concentrations and wind data from the three ozone monitoring locations to compare wind directional frequency as compared to ozone readings. Each of the following 3 slides has wind roses for 2014, 2015 and 2016.

West Greenwich – **SLIDE #34** The 2014-2015 pollution roses revealed a more typical wind regime from the west southwest, southwest, and even some south, which resulted in exceedances of the 8-hr standard. When advancing to the 2016 rose, the exceedance under a northwest and west northwest flow associated with the May 2016 event is evident.

Narragansett – **SLIDE #35** Per the 2014 and 2015 pollution roses, high ozone surface winds are statistically from favorable transport directions of west, west southwest, and southwest. The 2016 rose again shows the unusual elevated ozone from the west northwest component.

East Providence – **SLIDE #36** The East providence location is a more susceptible to spring time bay breezes, when the water land temperature differences are the greatest, which can shift prevailing winds southwest to more of southeast direction. Additionally, due to the frictional change of air flow going from the land over the West Bay to the East Bay and a Meteorological phenomenon known as the Ekman spiral, this location in particular may see higher ozone concentrations under a variety of flows, including southeast (transport brought in on bay breeze), south, southwest, west southwest, and west, as indicated by the pollution roses for 2014 and 2015. However, the May 2016 signal is still evident, with a rare high ozone resulting from a west northwest surface flow.

When examining East Providence more closely on the May 2016 exceptional event, it appeared the ozone on 5/26/16 did not climb as high if not having been impacted by a bay breeze. At 11AM the winds shifted from the southwest (213 degrees) to south southeast (171 degrees) and eventually to southeast (157 degrees), with a 6 ppb drop in the hourly ozone value from 85 ppb to 79 ppb (**SLIDE #37**). Narragansett (**SLIDE #38**) and West Greenwich (**SLIDE #39**) did not experience a sea breeze and winds retained a westerly component, while ozone values remained high.

Air Quality Model Performance during Exceptional Event

Throughout the exceptional event, both the CMAQ and NOAA models vastly underperformed in tracking the plume, when compared to observations. On 5/24/15 (**SLIDE #40**) the NOAA model did not capture any of the exceedances around Lake Ontario and Lake Erie to our northwest, the day prior to the exceptional event in RI. As the plume impacted RI and the Northeast on 5/25/16, the under prediction continued by an entire health impact category on the Air Quality index, with models only predicting –MODERATE along the immediate coast of Southern New England. Observed ozone concentrations reached UNHEALTHY at monitors in CT and RI.

Refer to the images on **SLIDE #41** and **SLIDE #42**, provided to RIDEM by Joel Dreesen of The Maryland Department of the Environment. The plotted maps of interpolated NOAA/CMAQ predicted concentrations versus observed 8-hour concentrations tracks the substantial negative bias in the models with the plume as it tracks into Rhode Island from the northwest. The negative bias reaches approximately 15-25 ppb on 5/25/16, continuing on to 5/26/16 (**SLIDE #42**). By 5/27/16, as the plume exits the region, the modeled prediction goes from a negative bias to a more neutral bias as the smoke impact lessened. By that time, the weather pattern

and trajectories indicate a more southerly, cleaner flow off the Atlantic for Rhode Island, which displaced some of the plume out of the region and mixed in cleaner marine air. Both models do not assimilate gaseous smoke emissions in predicting ozone concentrations, which resulted in the negative bias.

Monitoring Data and Smoke Evidence at RI Monitors

Smoke is a complex mixture of carbon dioxide, water vapor, carbon monoxide, particulate matter, hydrocarbons and other organic chemicals, nitrogen oxides, and trace minerals. The individual compounds present in smoke number in the thousands. Smoke composition depends on multiple factors, including how efficiently a fuel burns, the fuel type and moisture content, the fire temperature, wind conditions and other weather-related influences, whether the smoke is fresh or "aged," and other variables (https://www3.epa.gov/airnow/wildfire_may2016.pdf).

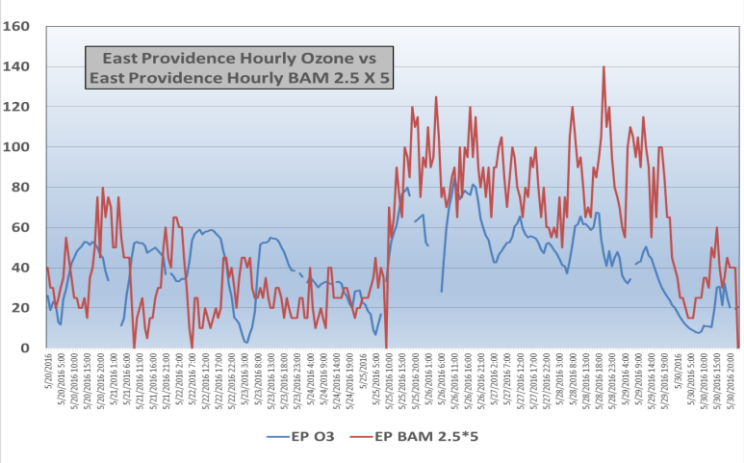
In addition to the many ingredients that comprise of fire smoke, ozone precursor emissions of NOx and VOCs can generate ozone within the plume or combine with emissions from other sources to generate ozone (*Jaffe, D.A., Wigder, N.L., 2012. Ozone production from wildfires: A critical review. Atmospheric Environment 51, 1-10*). There are many variables that impact the magnitude and ratios of fire emissions, including the acreage burned, the characteristics of the fuel burned, and the meteorological conditions (*Akagi, S., Craven, J., Taylor, J., McMeeking, G., Yokelson, R., Burling, I., Urbanski, S., Wold, C., Seinfeld, J., Coe, H., 2012. Evolution of trace gases and particles emitted by a chaparral fire in California.Atmospheric Chemistry and Physics, 12, 1397-1421*). In an analysis conducted by (*Pfister, G., Wiedinmyer, C., Emmons, L., 2008. Impacts of the fall 2007 California wildfires on surface ozone: Integrating local observations with global model simulations. Geophysical Research Letters, 35*), smoke impacts were modeled for the busy 2007 California wildfire season. An increase in observed ozone was found when the model predicts a strong impact of pollution from the fires, where measured afternoon 8-hour concentrations increased, on average, by about 10 ppb. The findings demonstrate that intense wildfire periods can significantly increase the frequency of ozone concentrations exceeding current U.S. health standards.

The resultant rapid increase in smoke parameters (i.e., PM2.5, black carbon and carbon monoxide) and ozone that all three monitors in Rhode Island experienced under the aforementioned meteorological conditions and trajectories is quite remarkable. The response for these pollutants at~~with~~ the monitors is revealed in the upcoming plots.

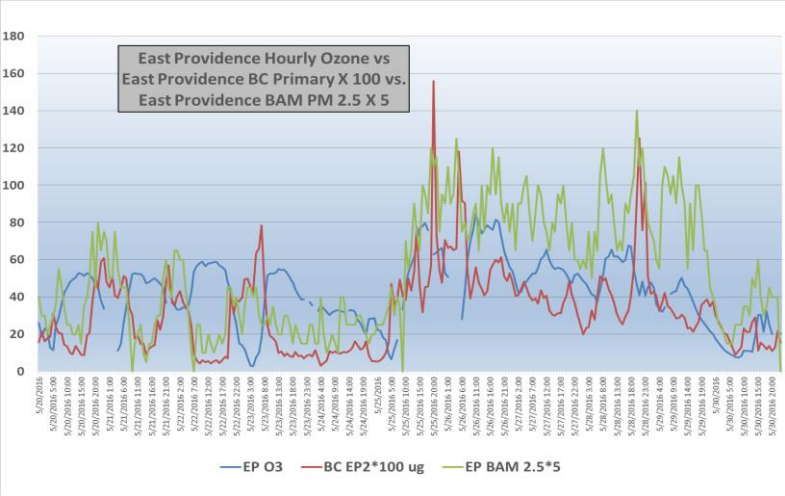
Commented [EPA30]: As mentioned in comments #7 and 8, it is recommended that additional BC data, delta C (calculated from aethalometers) and information from the Chemical Speciation Network be used to help support the demonstration.

Note that scales for all non-ozone parameters have been normalized as indicated on the slides to provide for better scaling between different parameters.

All PM 2.5 was measured by Met One BAMs with ozone by measured by Thermo Fisher Scientific 49i analyzers. At East Providence, PM 2.5 curves climbed together as the plume arrived early on the morning of 5/25/16 at East Providence.

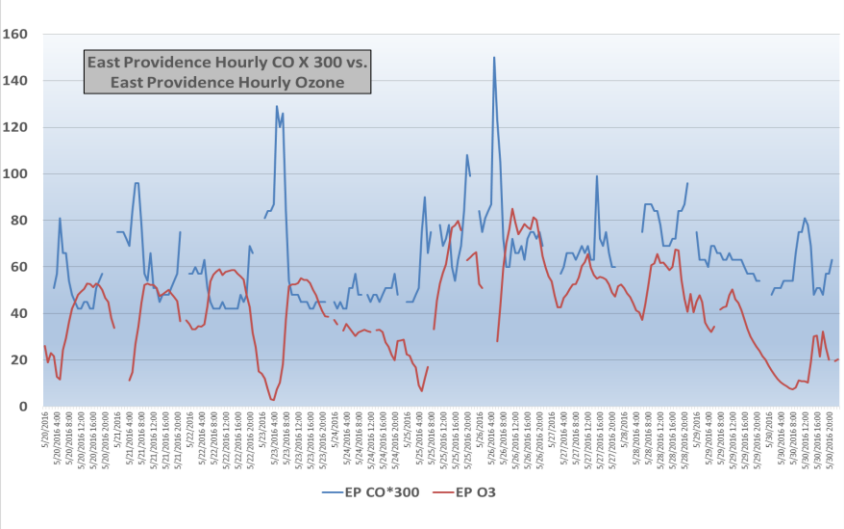


Black Carbon also compared favorably with ozone and PM 2.5. Black carbon primary was measured by Magee Scientific AE 33 Aethalometer.

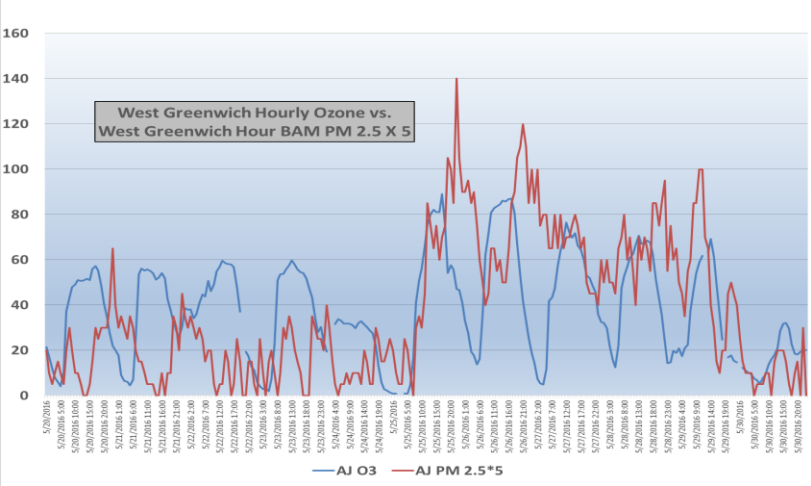


Commented [EPA31]: For clarity, it would be helpful to keep color coding consistent between graphs. According to previous graph it would make most sense to continue to use red for BAM $PM_{2.5}$ and use green for BC, and so on.

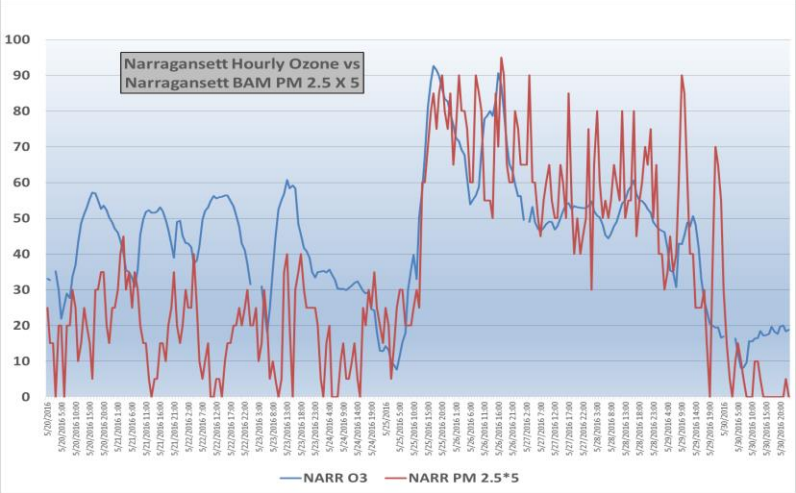
Hourly carbon monoxide versus hourly ozone at East Providence.



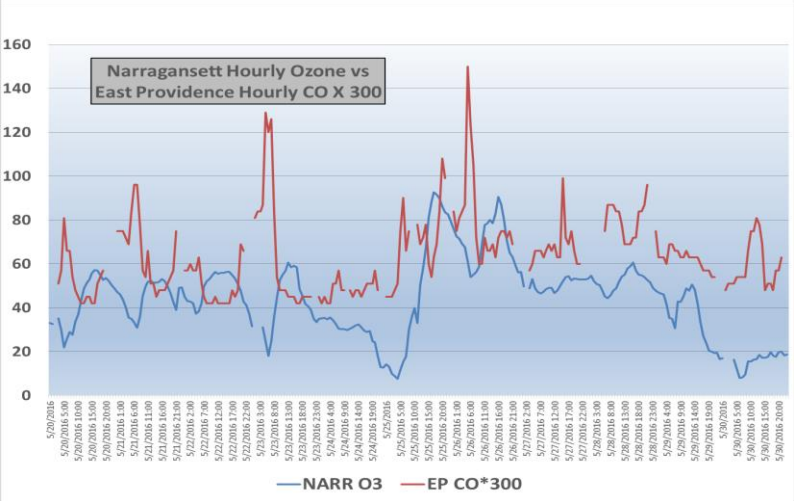
West Greenwich experienced a similar climb for both hourly ozone and hourly PM 2.5 as the plume impacted the monitor early on 5/25/16.



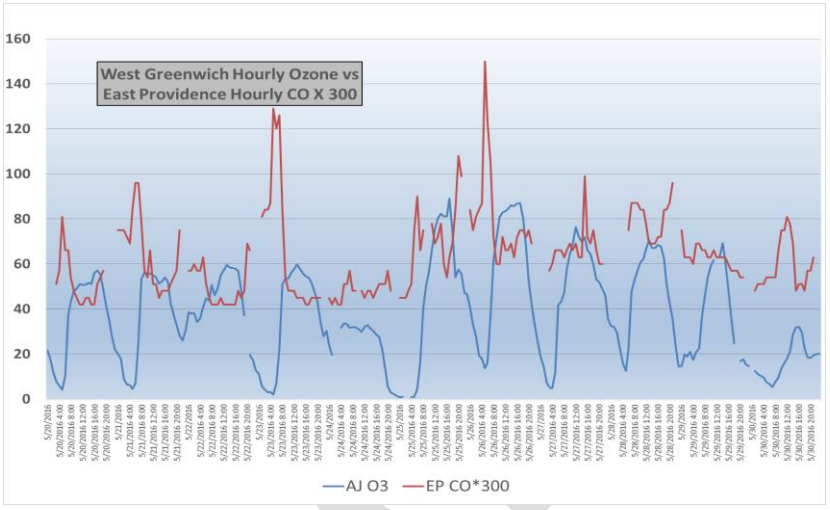
Narragansett hourly ozone and hourly PM 2.5 curves responding to the plume arrival.



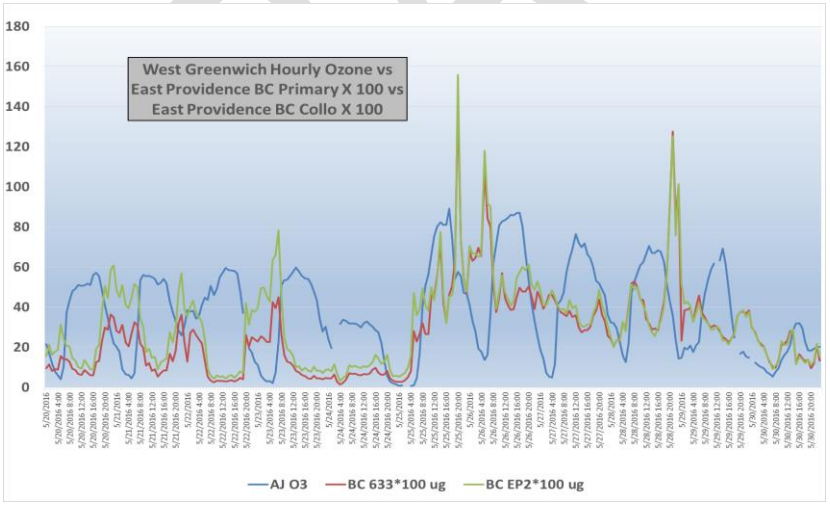
Narragansett hourly ozone and East Providence CO.



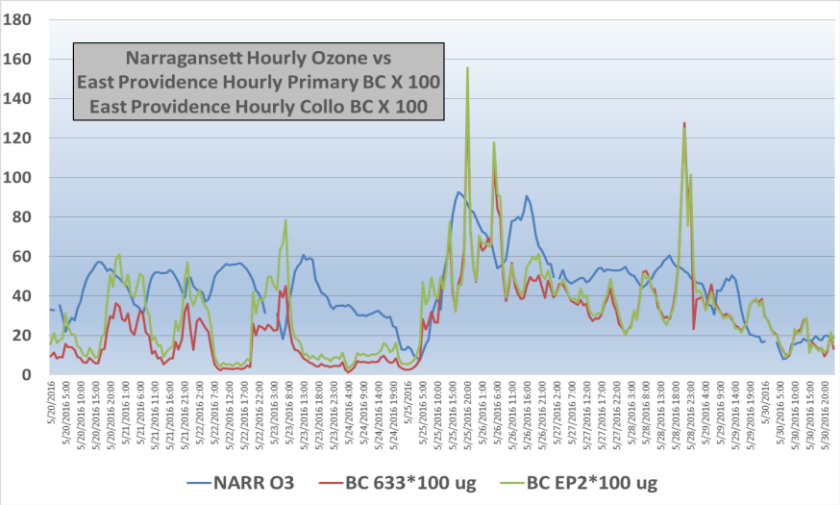
West Greenwich hourly ozone and East Providence hourly carbon monoxide.



West Greenwich hourly ozone versus East Providence hourly black carbon and a co-located hourly black carbon, measured by a Magee Scientific AE21 Aethalometer. The co-located black carbon measurements are typically in very good agreement.



Narragansett hourly ozone versus East Providence hourly black carbon primary and co-located.



Event Caused by Human Activity that is Unlikely to Recur at a Particular Location

Clean Air Act Section 319(b)(1)(A)(iii) defines an exceptional event as "an event caused by human activity that is unlikely to recur at a particular location or a natural event". The current exceptional events rule at 40 CFR Section 50.14(c)(3)(iv)(A) requires that evidence be provided in an exceptional event demonstration that this definition has been met.

There has been no official cause determined for the Fort McMurray fire. However, several Canadian officials have strongly suggested that at the time, there was no ongoing weather pattern that would be able to produce lightning, which according to the Canadian National Fire Database accounts for 47% of fires, with human activity the number one cause. In these instances with a lack of lightning, it is inferred that the cause if human activity, especially in springtime when there is more outdoor human activity.

Below are excerpts of press releases from Canadian news organizations regarding the event with links to the article online.

"*Mike Flannigan, a professor of wildland fires at the University of Alberta, says the fire's proximity to the city, as well as data that shows there were no lightning strikes in the area, lead him to believe the cause of the fire was likely human."*

Flannigan said weather conditions in Western Canada have been perfect for wildfires as —the warm, dry winter has led to an abundance of dead, dry leaves and wood ready to light up. "It's really extreme conditions," he said, adding that the low humidity and lack of green vegetation combined with windy conditions contributed to the incredibly intense fire in the northern Alberta city.

http://globalnews.ca/news/2684741/fort-mcmurray-wildfire-likely-caused-by-humans/

From Alberta Senior Wildfire Manager, Chad Morrison….

While the investigation continues into the inferno known informally as 'The Beast,' Chad Morrison told the Globe and Mail on Saturday that the fire was probably the result of human action–a broad category that includes everything from careless ATV drivers to issues with power lines. "Human-caused really means anything other than lightning. It's most likely human caused, but we're continuing to investigate," Mr. Morrison said.

He continues……

"It wasn't natural," said Mr. Spring of the fire that ignited on May 1. "There was no probability of a fire starting naturally that day. There was no lightning in the forecast, nothing that we look for."

http://www.theglobeandmail.com/news/national/fort-mcmurray-wildfire-most-likely-human-caused-alberta-senior-wildfire-manager-says/article30279836/

The Royal Canadian Mounted Police (RCMP) have been investigating the cause of the fire, which may never be officially determined.

Cpl. Hal Turnbull said this area is popular with hikers and ATV riders.

"It's not an area that's remote and isolated, it's an area that's frequently accessed by the individuals who reside in and around the Fort McMurray area," Turnbull said. Because of the unique scope and magnitude of the fire, Turnbull said, it's only natural that police would investigate the cause.

http://www.cbc.ca/news/canada/edmonton/fort-mcmurray-wildfire-cause-investigation-rcmp-1.3635241

In a news release, the RCMP said that investigators ruled out lightning as the "probable cause" of the wildfire, which began in early May and prompted a massive evacuation in several Fort McMurray communities. Officials have dubbed the wildfire MWF-009.

As a result, the RCMP is asking for the public's help in the investigation into the cause of the wildfire, which an airborne forestry crew first spotted 15 kilometres southwest of Fort McMurray on May 1.

http://www.ctvnews.ca/canada/fort-mcmurray-wildfire-likely-result-of-human-activity-rcmp-1.2946737

Cpl. Hal Turnbull with the Alberta RCMP K Division said as they rule out natural causes such as lightning, they're left with human activity-related causes.

http://www.metronews.ca/news/calgary/2016/06/14/rcmp-want-publics-help-in-fort-mcmurray-fire-investigation.html

The Exceptional Events Rule (40 CFR 50.1(n)) defines a wildfire as "…any fire started by an unplanned ignition caused by lightning; volcanoes; other acts of nature; unauthorized activity; or accidental, human-caused actions, or a prescribed fire that has developed into a wildfire. A wildfire that predominantly occurs on wildland is a natural event." The 2016 Exceptional Events Rule revisions also codified the following definition of wildland: "Wildland means an area in which human activity and development are essentially non-existent, except for roads, railroads, power lines, and similar transportation facilities. Structures, if any, are widely scattered" (40 CFR 50.1(o)).

Based on the evidence above, the Fort McMurray event qualifies as a wildfire because unplanned human activity or arson is assumed to have caused the unplanned event. EPA generally considers the emissions of smoke and ozone precursors from wildfires on wildland to meet the regulatory definition of a natural event at 40 CFR 50.1(k). This wildfire event occurred predominantly on wildland as noted. Rhode Island DEM has shown that the Fort McMurray wildfire is a natural event and may be considered for treatment as an exceptional event.

Not Reasonably Controllable or Preventable

Clean Air Act Section 319(b)(1)(A)(ii) requires that an exceptional event be "not reasonably controllable or preventable". The current exceptional events rule at 40 CFR Section 50.14(c)(3)(iv)(A) also requires that evidence be provided in an exceptional event demonstration that the event was not reasonably controllable or preventable. This criterion applies to both natural events and events caused by human activity unlikely to recur.

Below are excerpts of press releases from Canadian news organizations regarding the event with links to the article online.

Few on the front lines had ever seen anything like it. "It's an unprecedented fire with respect to the rate it spread, how it involved the community," said regional fire chief Darby Allen earlier this week, after cooler temperatures and higher humidity allowed crews to get a handle on the fire.

"The way this thing happened, the way it travelled, the way it behaved – they're rewriting their formulas on how fires behave, based on this fire," he said.

"No amount of tankers or resources, or no size of firebreak, could have prevented it from hitting the community that day," Morrison said. "Sometimes Mother Nature is going to do what it wants to do and bad things happen."

https://www.theguardian.com/world/2016/may/15/alberta-wildfire-the-beast-fort-murray-canada

On the first day of May near-record temperatures and bone dry forests created the perfect conditions for a fire to start.

A wildfire crew landed almost immediately after the fire was discovered and began to tackle the two-hectare fire, which is larger than two Canadian football fields. As the crew approached, MWF-009 was already sending sparks into the sky and leaping to the crowns of tall trees.

"When a fire starts at that time it moves to a full crown within minutes. It was in the crowns and rolling by the time the helicopters showed up," Mr. Morrison said. "When these fires occur, Mother Nature is going to do what it's going to do. It's going to challenge us."

http://www.theglobeandmail.com/news/national/fort-mcmurray-wildfire-most-likely-human-caused-alberta-senior-wildfire-manager-says/article30279836/

Based on the information from this demonstration, the Fort McMurray fire started in a wildland ("wilderness area known as the Horse River Trail System") due likely to human activities that authorities have not been able to officially determine. RIDEM is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually made would have been reasonable. Therefore, emissions from this wildfire were not reasonably controllable or preventable.

Public Comment

Exceptional Events Rule (40 CFR 50.14(c)(1)(i)) determines that air agencies must "notify the public promptly whenever an event occurs or is reasonably anticipated to occur which may result in the exceedance of an applicable air quality standard." Additionally, according to 40 CFR 50.14(c)(3)(v), air agencies must "document [in their exceptional events demonstration] that the [air agency] followed the public comment process and that the comment period was open for a minimum of 30 days…." Further, air agencies must submit any received public comments to the EPA and address in their submission those comments disputing or contradicting the factual evidence in the demonstration.

RIDEM posts a daily air quality forecast available on the following websites.

http://www.dem.ri.gov/programs/air/air-quality-forecast.php

http://airnow.gov/

Additionally, on days of forecasted exceedances, RIDEM issues a formal press release sent via an email list to stakeholders, notifies all local television stations, the National Weather Service, and posts to social media.

RIDEM posted this exceptional events demonstration and notice of public comment from X to X, which was available at the following URL for a period of 30 days. XXXXXXXX

Public comments to be added later…….

State of Rhode Island and Providence Plantations
State House
Providence, Rhode Island 02903-1196
401-222-2080

Gina M. Raimondo
Governor

September 27, 2016

Curt Spalding
Regional Administrator
US Environmental Protection Agency Region I
5 Post Office Square, Suite 100
Mail Code: ORA01-4
Boston, MA 02109-3912

Dear Mr. Spalding:

Pursuant to the requirements of Section 107(d)(1) of the Clean Air Act Amendments of 1990, Rhode Island is hereby submitting its recommendation for the State's attainment status designation for the 2015 revised National Ambient Air Quality Standard (NAAQS) for ozone. Section 107(d)(1) defines nonattainment areas as areas that do not meet, or that contribute to ambient air quality in a nearby area that does not meet, the NAAQS for a pollutant.

A site is in violation of the eight-hour NAAQS if the monitored design value for that site is greater than 70 parts per billion (ppb). The design value is calculated by averaging the fourth highest maximum daily eight-hour ozone concentration measured at a site each year in three consecutive years. The eight-hour ozone design values for the three Rhode Island ozone monitoring sites for the most recent three-year period with certified data, 2013 – 2015, are included in the table below.

Site	County	Design Value (ppb)
W. Greenwich	Kent	70
Narragansett	Washington	73
E. Providence	Providence	70

The design value for the Narragansett monitoring site exceeds 70 ppb. On the basis of the most recent certified data (2013 – 2015), our designation recommendation should be nonattainment. However, we ask that the EPA consider 2014 – 2016 data when making the designation decision. The 2014 – 2016

data set is preliminary and not yet certified, however it will be certified by the time EPA is required to make its designation for the 2015 ozone NAAQS. The eight-hour ozone design values for the three Rhode Island ozone monitoring sites for the 2014 – 2016 three-year period were calculated as follows:

Site	County	Design Value (ppb)
W. Greenwich	Kent	70
Narragansett	Washington	70
E. Providence	Providence	68

No monitoring site in Rhode Island would exceed the 70 ppb standard based on this data set. Therefore, we ask that you consider a designation recommendation of attainment per the 2014 – 2016 data set.

The EPA's guidance for designating areas for the 2015 revised ozone NAAQS[1] states that the EPA intends to consider information relevant to designations associated with counties in the Combined Statistical Area (CSA) or the Core Based Statistical Area (CBSA) associated with the violating monitor for determining the boundaries of a nonattainment area. The Rhode Island monitors are located in the Providence–Warwick, RI-MA CBSA, which includes all five of the Rhode Island counties as well as Bristol County in Massachusetts.

For ease of administration, I am recommending that, as with previous ozone NAAQS, the Rhode Island 2015 ozone nonattainment (or attainment) area be defined by the boundaries of the State of Rhode Island, rather than the boundaries of the CBSA.

Rhode Island is keenly aware that the State's ozone levels are strongly influenced by upwind states' emissions. Therefore, for Rhode Island's ozone air quality to continue to improve, it is essential for the EPA to fully address significant contribution responsibilities of upwind states under section 110(a)(2)(D) of the Clean Air Act.

If you have any questions about this issue, I encourage you to contact Douglas McVay or Laurie Grandchamp at the Rhode Island Department of Environmental Management's Office of Air Resources at (401) 222-4700.

Sincerely,

Gina M. Raimondo
Governor

1 Memo from Janet G. McCabe, Acting Assistant Administrator, US EPA, to Regional Administrators, "Area Designations for the 2015 Ozone National Ambient Air Quality Standards," February 25, 2016.